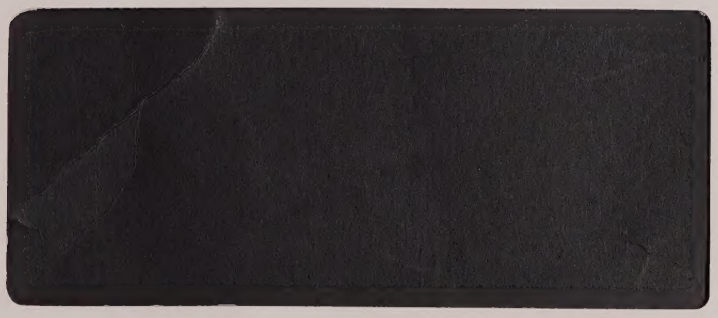

ADVANCED
INSTRUMENTATION

DONNER SCIENTIFIC COMPANY

001.0313

Operating Handbook

Donner Model 1200

Sine Wave Generator

Patent Notice: Application has been made for United States Letters Patent covering the circuit and design of this instrument. Reproduction of the equipment or any part of this handbook, without written authorization by Donner Scientific Company, is specifically prohibited.

MITCHELL SPEAIRS CO.
Manufacturers' Representative
3801 Westcliff Road So.
Ph. WA6-4444 WA6-4445
Fort Worth 9, Texas

Serial Number _____

DONNER MODEL 1200

SINE WAVE GENERATOR

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WARRANTY

Donner instruments are warranted during a period of one year from date of shipment to original purchaser to be free from defects in material and workmanship. This warranty does not apply to vacuum tubes, except as they are warranted by tube manufacturers. The liability of Seller under this warranty is limited to replacing or repairing any instrument or component thereof which is returned to Buyer at his expense during such period and which has not been subjected to misuse, neglect, improper installations, repair, alteration, or accident. Seller shall have the right of final determination as to the existence and cause of a defect. In no event shall Seller be liable for collateral or consequential damages. This warranty is in lieu of any other warranty, express, implied or statutory, and no agreement extending or modifying it will be binding upon Seller unless in writing and signed by a duly authorized officer.

RECEIVING INSPECTION

Every Donner instrument is carefully inspected and is in perfect working order at the time of shipment. Each instrument should be checked as soon as received. If the unit is damaged in any way or fails to operate, a claim should immediately be filed with the transportation company.

REPAIRS

Whenever a Donner instrument requires service, the nearest Donner representative should be contacted; all representatives will provide immediate service or arrange factory returns when necessary.

Please specify both model and serial number in all correspondence concerning Donner instruments. Address all inquiries on operation or applications of Donner instruments to your nearest sales representative or Sales Manager, Donner Scientific Company, 2829 Seventh Street, Berkeley 10, California

GENERAL DESCRIPTION

The Donner Model 1200 Sine Wave Generator is a true Wien Bridge oscillator having exceptionally low distortion, very wide frequency range and excellent stability. This instrument employs an entirely new circuit, developed by the Donner Scientific Company. It covers frequencies between 1 cycle and 1 megacycle per second in six overlapping decades. Distortion is less than 0.1% at a maximum signal level of approximately six volts rms (open circuit). A bridged-T attenuator, having a constant output impedance of 600 ohms, provides up to 50 decibels attenuation of this output signal.

SPECIFICATIONS

Frequency Range:	1 cps to 1 mc, plus overlap, in 6 decades (1-10 cps, 10-100 cps, 100 cps-1 kc, 1-10 kc, 10-100 kc, 100 kc - 1 mc).
Calibration Accuracy:	2% $\pm$ 0.2 cps, at any setting.
Frequency Stability:	Maximum drift 1% $\pm$ 0.1 cps, including warm-up; line voltage variations of $\pm$ 10% change frequency less than 0.5%.
Frequency Response:	Constant within $\pm$ 1/2 db at any setting.
Output Voltage:	6 volts RMS, open circuit; no DC. One side grounded.
Output Impedance:	600 ohms at any setting of output attenuator (bridged-T network, logarithmic taper).
Distortion:	Less than 0.1% over most of the frequency range.
Hum and Noise:	Less than 0.1% of output signal at any setting.
Tube Complement:	1 each Types 6CL6, 5687 and 5Z4.
Power Source:	115 volts ($\pm$ 15%), 60 cps, 60 watts; 230 volts, 50 cps, special order.
Cabinet Size:	7-3/8 wide x 10-3/8 high x 12-1/2 inches deep.
Weight:	21 pounds (net); 25 pounds (shipping).

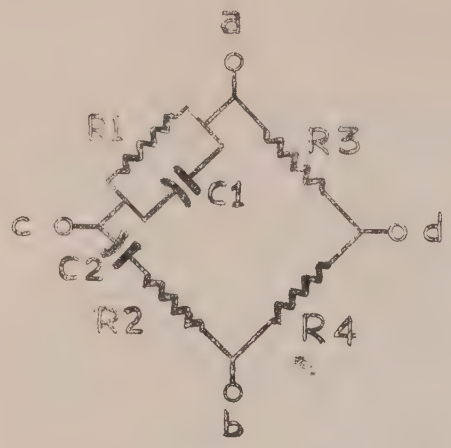


FIGURE 1

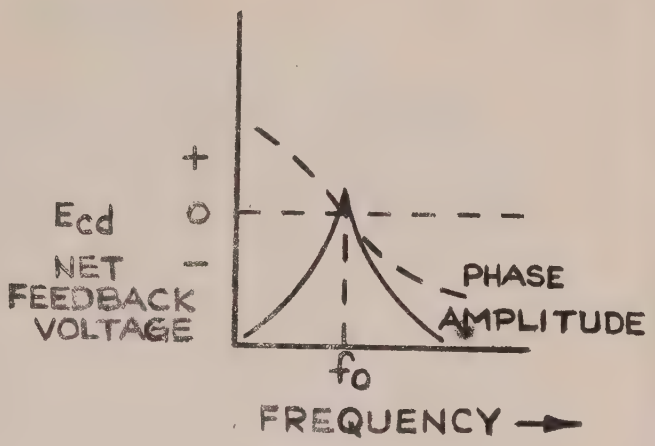


FIGURE 2

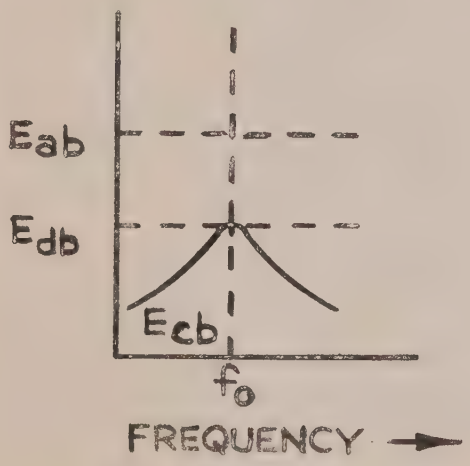


FIGURE 3

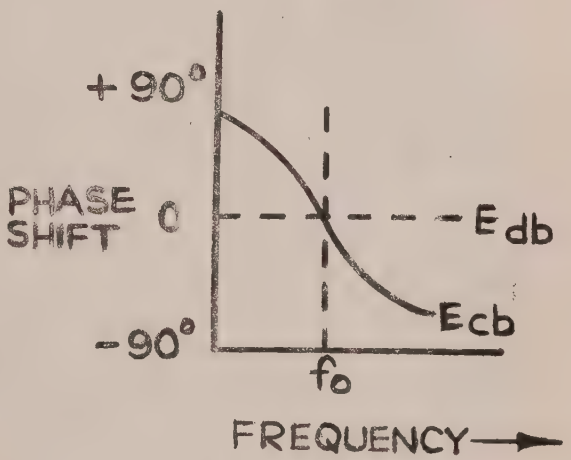
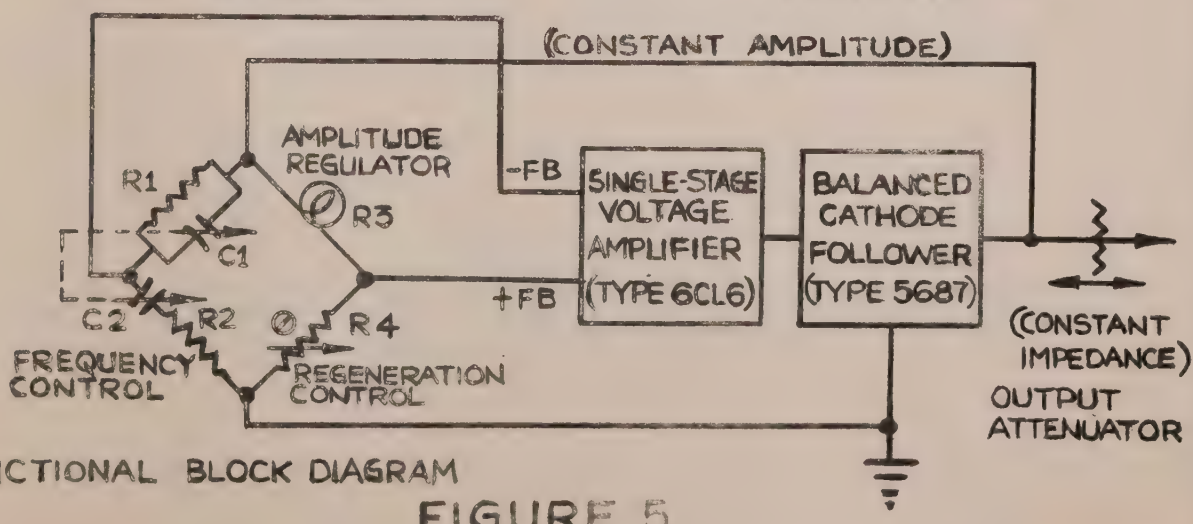


FIGURE 4



FUNCTIONAL BLOCK DIAGRAM

FIGURE 5

CIRCUIT DESCRIPTION

Figure 1 shows the basic form of the Wien Bridge which is used in the Donner Model 1200 Sine Wave Generator. The oscillator is shown in block diagram form in Figure 5. A single stage, wide-band amplifier utilizing a Type 6CL6 vacuum tube is directly coupled to a balanced cathode follower using a Type 5687 tube. This cathode follower effectively isolates the video amplifier from the output circuit. It also provides a very low driving impedance for the Wien Bridge; this minimizes the amount of driving impedance in series with the bridge. The amplifier has constant gain over the range of frequencies to be derived from the oscillator. The positive feedback is also "flat" over a similar frequency range. Therefore, this return channel tends to promote oscillation at any or all frequencies over a very wide band. However, this positive feedback is directly opposed by negative feedback in an additional return channel, through which a part of the output is available for opposing any grid voltage variation. At frequencies other than that of bridge balance, the negative feedback is greater and thereby prevents oscillation. At the frequency of bridge balance, the output voltage from the negative feedback channel reaches a null or minimum. The net feedback at this one frequency becomes positive by a sufficient amount to permit oscillation. At frequencies other than that of oscillation, the feedback, being predominately negative, suppresses any output signals--including harmonics of the oscillation frequency.

This action may be seen by a study of Figures 2 and 3. Figure 3 shows the voltages which appear at points c and d with respect to point b, as a function of frequency. E_{cb} is applied to the amplifier grid as negative feedback and E_{db} is applied to the amplifier cathode as positive feedback. The net signal voltage between amplifier grid and cathode is then E_{cd}, shown in Figure 2. The bridge balances at a frequency

$$f_o = \frac{1}{2\pi R_1 C_1}$$

provided that:

$$R_1 = R_2$$
$$C_1 = C_2$$
$$R_3 = 2R_4$$

R_1 and R_2 are precision resistors selected by the frequency multiplier switch. C_1 and C_2 are variable capacitors which are ganged and held within very close tolerance; they are rotated by the main tuning dial.

A sharp null in the negative feedback voltage, E_{cd}, occurs at the bridge balance point. The amplitude of oscillation is controlled by the use of a tungsten-filament lamp, R_3. As the oscillation amplitude increases, the lamp current and temperature rise. This causes R_3 to increase in resistance, thus reducing the positive feedback to the minimum value required for maintenance of oscillation. This lamp is especially chosen to have both proper time constant and operating temperature for proper amplitude regulation, without the introduction of excessive distortion at low frequencies. No direct (biasing) current flows through the lamp. The regulating action is symmetrical and maximum regulating efficiency is obtained without affecting the bias voltages of the amplifier.

The output signal voltage is taken from the same point as is the signal which drives the bridge. Thus, the output signal comes from inside the negative feedback loop at the point of minimum distortion. The signal is applied to a bridged-T attenuator having constant input and output impedance of 600 ohms. This attenuator is connected to the output terminals to provide up to 6 volts rms open-circuit at 600 ohms.

The power supply within this instrument uses a constant-voltage transformer to minimize the effect of line voltage variations upon the output frequency and amplitude. A Type 5Z4 heater-cathode rectifier is employed for minimum power supply impedance, also to protect the filter capacitors against excessive voltage surges caused by unequal warm-up times of rectifier and amplifier tubes.

INSTALLATION

No special installation is necessary for the Donner Model 1200 Sine Wave Generator, beyond connecting the AC line cord to the proper power source: 100-130 volts, 60 cps, for the standard version; 200-260 volts, 50 cps, if so ordered. Sufficient clearance should be allowed between the instrument and adjacent equipment to assure adequate ventilation. This instrument may be considered to be simply a source of sine-wave voltage having 600 ohms internal impedance. On the highest frequency range, care should be taken to avoid excessive capacitance across the output terminals; capacitive reactance represents a decreasing impedance with increasing frequency, which may affect the frequency response and stability.

A special three-conductor input power cord is furnished with this instrument. The offset center prong is the external connection to the chassis and should be solidly connected to an external ground. For use with two-prong receptacles, a three-prong-to-two-prong adapter is furnished; the ground wire protruding from this adapter may be used to connect the instrument chassis to an external ground.

OPERATION

To place the instrument in operation, turn the POWER switch ON. Lighting of the pilot lamp on the front panel indicates that the instrument is receiving power. A few minutes of warm-up are necessary to achieve fully stable operation although initial drift is slight. Select the desired operating frequency by setting the main tuning dial and the FREQUENCY switch so that their product equals the desired frequency. The AMPLITUDE control adjusts the amplitude of the sine wave appearing at the OUTPUT terminals. The output voltage varies approximately logarithmically with rotation (linearly in terms of decibels or nepers). Since the amplitude regulator circuit is designed to minimize tuning and switching transients, the selected frequency and amplitude will stabilize within a very few cycles of oscillation.

MAINTENANCE

To remove the instrument from its case for servicing, remove the two 8-32 screws at the back of the cabinet. Then slide the chassis and front panel assembly forward until clear of the cabinet. Tubes, wiring, and adjustments will now be completely accessible.

Except for the renewal of the fuse, pilot light, or tubes, servicing should be referred to the nearest Donner Scientific Company representative.

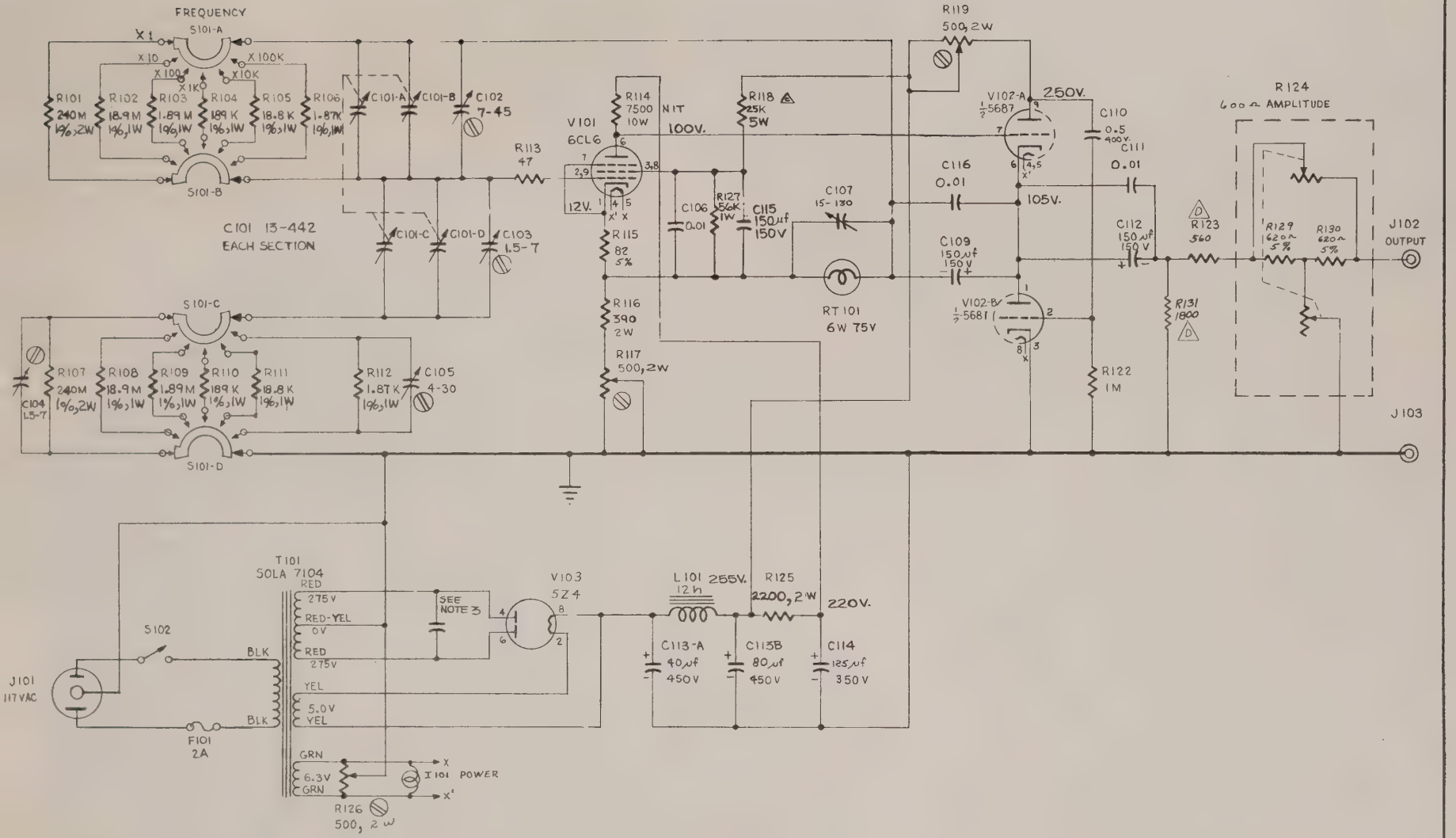
Regulator lamp RT-101 is a special type rated at 6 watts, 75 volts. It is operated far below this rating, however, and should last indefinitely. If it is replaced for any reason, it may be necessary to readjust the regeneration control, R-117. This is done by adjusting R-117 for 6 volts rms output into a high-impedance metering circuit with the AMPLITUDE control, R-124, turned to its maximum clockwise position. R-117 may be set for as much as 8 volts rms output, but with slight increase in distortion at extremes of frequency range.

When replacing any of the tubes (with the exception of the Type 5Z4 rectifier) distortion measurements should be made to determine whether or not the instrument still meets the specifications set forth in this manual. These measurements are best made by means of a low-distortion wave analyzer, such as the Donner Model 2100. The wave analyzer should have a lowest usable reading of -65 db or better, for proper adjustment of the Model 1200. The second harmonic distortion of the Model 1200 may be minimized by setting its operating frequency to approximately 500 cps with the AMPLITUDE control (R-124) at approximately 50% rotation. Then tune the wave analyzer to the second harmonic of the operating frequency, 1000 cps. The Balance control, R-119, may now be adjusted for minimum second-harmonic distortion.

Excessive distortion, which cannot readily be eliminated by adjusting R-119, is probably caused by defective tubes. Either excessive grid current in the Type 6CL6 video amplifier or current leakage across tuning circuit insulation may also result in failure of the instrument to oscillate on the lowest frequency range. Insulators associated with the tuning circuit must be kept clean. Defective or gassy tubes should be replaced. Failure of other circuit components can usually be detected by measurements of voltages on tube elements and comparison with the values given on the circuit diagram at the end of this handbook.

R-126, which is located at the back end of the chassis adjacent to the power input connector, is the filament-center-tap balance control. With the instrument installed in its cabinet and the frequency of operation set to within one or two cycles per second of the power line frequency (58-62 cps or 48-52 cps), adjust R-126 for the minimum amount of amplitude variation due to inter-modulation between the oscillator frequency and the power line frequency. This amplitude variation of the output signal is best observed on a cathode-ray oscilloscope.

1	R125 - 2200 WAS 1200	120	A	7-17-56
1	REMOVED R120, C117, R128 & C108	120	B	7-17-56
	R118 WAS N.I.T., ADDED VOLTAGES	151	C	8-27-56
	XFC3 WAS 330 Ω; ADD R131	204	D	12/13/56



NOTE

UNLESS OTHERWISE NOTED

1. ALL RESISTORS ARE ½W 10%
2. ALL CAPACITORS VALUES LESS THAN ONE ARE IN MICROFARAD, ONE & OVER ARE IN MICROMICROFARAD
3. CAPACITOR IS SUPPLIED WITH & MATCHED TO T101.

DATE 1-27-55	UNLESS SPECIFIED, DIMENSIONS: INCHES TOLERANCES:					
DRAWN R.L. NEGLEY	FRACTIONAL ± 1/64					
CHECKED	DECIMAL ± .005	DET. NO.	ITEM	SIZE & MATERIAL OR DWG. NO.	STOCK NO.	QTY.
APPROVED 7/18/56	ANGULAR ± ½°					
	SCALE:		DONNER SCIENTIFIC COMPANY			
MODEL 1200	PART OF:	TITLE SCHEMATIC - OSCILLATOR		DRAWING NO. 868		ISSUE D

ADVANCED INSTRUMENTATION

ANALOG COMPUTERS

SERVO ACCELEROMETERS

TEST INSTRUMENTS

DONNER SCIENTIFIC COMPANY

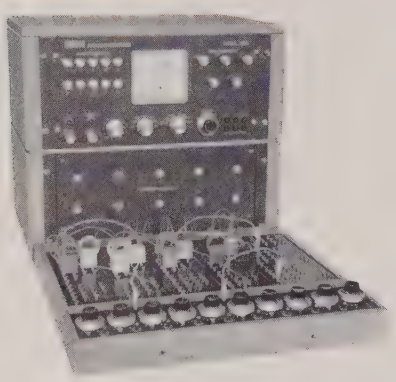
CONDENSED CATALOG

June 1958

ANALOG COMPUTING EQUIPM

Donner manufactures three models of analog computers for use as basic engineering and scientific tools of design, research, control, and instruction. They solve problems expressed as differential equations or transfer functions, simulate systems and processes, and function as control elements in systems.

NEW MODEL 3400 ANALOG COMPUTER WITH CHOPPER STABILIZED AMPLIFIERS
(Shown with Model 3430 Problem Board)



- 10 Chopper Stabilized wide-band dc operational amplifiers, output — 100 to + 100 volts, 13 ma.
- 0.1% or 1.0% passive components. Single or 10 turn coefficient potentiometers.
- Built-in controls, including Compute, Reset, and Hold.
- Repetitive or continuous operation.
- Integral meter for set-up, readout, and performance checking. Includes 0.1% null voltmeter.
- Reference power supply for 5 initial conditions and bias voltages.
- 2 thermionic diodes (floating), for limiting functions.
- All problem connections are available on the problem board.
- Two or more Model 3400 Analog Computers can be slaved together and operated from any one computer.
- May be operated with Donner auxiliary equipment listed on opposite page.

Model 3400, $2190.00

MODEL 3430 REMOVABLE PROBLEM BOARD

Push-connects to Model 3400 Analog Computer, carrying entire problem; several may be used interchangeably. Provides all connections to amplifiers, diodes, relays, 6 trunk lines, 2 multiplier channels and 1 function generator. Model 3430, $95.00

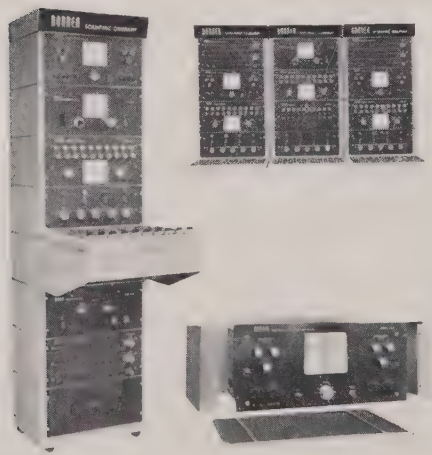
MODEL 3101 PLUG-IN AMPLIFIER

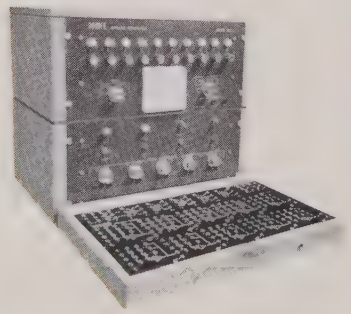
An integral part of the Model 3400, dc gain in excess of 50 million; maximum offset of a unity inverter, less than 200 μv/day; drift of unity integrator, less than 100 μv/sec; phase shift of unity inverter, less than 0.5 degrees at 1 kc. Amplifiers available separately.

MODULAR DESIGN

Versatility of the basic computer is easily increased by adding accessories in building-block manner. Each simply plugs in, without modification, and is supplied with one standard Donner cabinet module (2 sides, back, spacer), which bolts in place.

Castered floor-mounting bases and shelf unit (problem board support) are available for larger computing facilities. Two or more computers may be operated together to expand problem-handling capacity and flexibility.





MODEL 3000 DESK-TOP COMPUTER
(Shown with Model 3034 Problem Board)

A basic engineering tool, used for design, research, and instruction. Solves many problems, expressed as differential equations or transfer functions. Complete dc analog computer, with all power supplies.

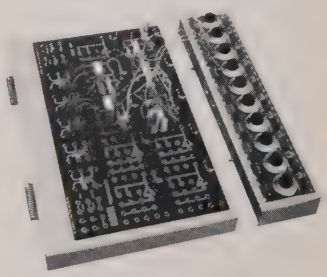
- 10 operational amplifiers, output —100 to +100 volts, 5 ma.
- 5 initial condition supplies, 0 to ±100 volts, 5 ma.
- 2 thermionic diodes (floating), for limiting functions.
- Built-in controls, including Compute, Reset, and Hold.
- Integral meter for set-up, readout and performance checking.

Model 3000, $1150.00

MODEL 3034 DETACHABLE PROBLEM BOARD
(Shown with Model 3073 Potentiometer Strip)

Push-connects to Model 3000 Computer, carrying entire problem; several may be used interchangeably. Provides all connections to amplifiers, diodes, relays, and two accessories. Utilizes Donner plug-in precision components.

Model 3034, $95.00



MODEL 3100 ANALOG COMPUTER

- A Complete Linear Computer
- 10 to 40 Chopper Stabilized Amplifiers
- 15 Initial Condition Potentiometers
- 20 to 40 Coefficient Potentiometers
- 0.1% Temperature-controlled Passive Components
- Latching Overload Lights
- Built-in Auxiliary Simulation Problem Board

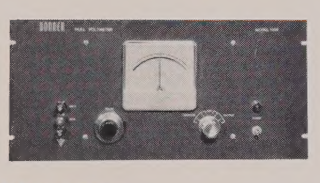
The Donner Model 3100, designed for industry, research laboratories and educational institutions, is a highly accurate and versatile medium-sized computer console. Flexibility is achieved by using plug-in dual stabilized amplifiers and plug-in modules of coefficient potentiometers. Accuracy is maintained by employing high quality 0.1% polystyrene capacitors and 0.1% resistors in a temperature-controlled environment. Operational amplifiers have a dc gain in excess of 5×10^7. When connected as a unity inverter, the maximum offset is less than 200 microvolts and the phase shift at 1000 cps is less than 0.2°. The removable AMP problem board accommodates non-linear equipment (see below) and has 70 additional trunk lines available for other computing components, or for interconnection between computers used in multiple.

Model 3100

10 Amplifiers and 35 Potentiometers, $12,775.00

30 Amplifiers and 55 Potentiometers, $16,650.00

AUXILIARY EQUIPMENT



MODEL 5000
NULL VOLTMETER

Compares applied voltage (or coefficient in computer problem) with internal standard, nulling with precision divider. Reads directly in range —100 to +100 volts with 0.1% accuracy. Serves also as precision voltage reference, —100 to +100 volts at 10 ma maximum, 0.05% regulation. Optional extra for Model 3000 only; integral part of Models 3100 and 3400.

With Standard Module, Model 5000, $245.00

Rack Mounting, Model 5000R, $230.00

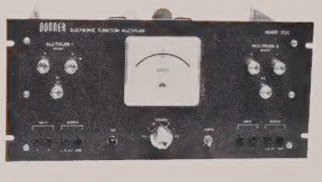
MODEL 3720
CYCLIC RESET GENERATOR

(For Repetitive Computation)

Resets and restarts computer at end of computing period (adjustable smoothly from 0.05 to 16 seconds). Furnishes synchronized oscilloscope sweep trigger, advanced in proportion to solution time to insure display from start. Power supply built-in. Optional extra for Model 3000 only; integral part of Models 3100 and 3400.

With Standard Module, Model 3720, $200.00

Rack Mounting, Model 3720R, $185.00

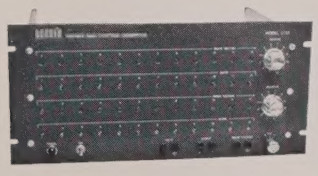


MODEL 3731
ELECTRONIC FUNCTION MULTIPLIER

Two separate channels (with common power supply) accept independently varying inputs U, V, X, and Y in range —100 to +100 volts, deliver products —0.01 UV and —0.01 XY. Four-quadrant multiplication or two-quadrant division.

With Standard Module, Model 3731, $995.00

Rack Mounting, Model 3731R, $980.00

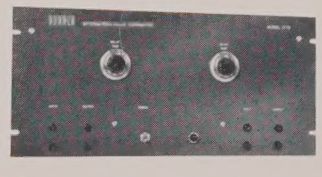


MODEL 3750
VARIABLE BASE FUNCTION GENERATOR

24-line segments may be adjusted to approximate almost any single-valued function. Generates powers, roots, empirical curves with inputs —100 to +100 volts. Integral power supply.

With Standard Module, Model 3750, $425.00

Rack Mounting, Model 3750R, $410.00



MODEL 3770
TRANSPORT DELAY GENERATOR

Self-contained unit furnishes two channels of adjustable transportation delay. Standard range of delay 0.5 to 10 seconds. Other ranges available are 0.005 to 0.1 and 0.05 to 1.0 seconds. Input and output range —100 to +100 volts. Used for accurate delay simulation in process and reactor control studies.

With Standard Module, Model 3770, $995.00

Rack Mounting, Model 3770R, $980.00

Any accessory shown available with complete cabinet and fan, if necessary, for $15.00 extra.

LINEAR SERVO ACCELEROMETERS

STANDARD VACUUM TUBE MODELS

All Donner models (see table below), ruggedized and hermetically sealed, are adaptable to any acceleration measuring problem. They are built to withstand changes in calibration or zero shift resulting from high overloads, and because of their servo construction they inherently have a fast recovery time. Donner units are well suited to airborne applications such as telemetering, navigation, control and guidance systems. In a typical application, the Model 4143 exercises a control function in the inertial stabilization of helicopters.

Half actual size

MODEL 4310 TRANSISTORIZED LINEAR SERVO ACCELEROMETER

- NON-LINEARITY PLUS HYSTERESIS —Within 0.05% deviation from best fitted straight line.
- STANDARD RANGES — Between ±0.1 g full range and ±30 g full range. Lower and higher ranges available on special order.
- RESOLUTION — Better than 0.0002% full scale.
- WEIGHT—3.5 ounces net.
- OUTPUT—±7½ v dc and/or ±1.5 ma full scale.
- EXCITATION—Plus 15 v dc, 5 ma max.; minus 15 v dc, 5 ma max.

MODEL 4005

MODEL 4112

MODEL 4143

SPECIFICATIONS	MODEL 4310	MODEL 4112	MODEL 4143	MODEL 4005
Non-Linearity Plus Hysteresis	0.05%	0.1% Full Scale		
Resolution	0.0002%	Better than 0.001%		
Reproducibility	0.1%	0.05%	0.1%	0.1%
Ranges	±0.1G to ±30G	±0.1G to ±20.0G	±0.5G to ±10.0G	±0.1G to ±20.0G
Output, max.	±7.5 volts	±15 volts	±45 volts	±35 volts
Excitation	Any ±15 vdc unreg. supply	Model 4071 $250.00	Model 4071S $250.00	Model 4051 $175.00
Magnetic Shielding	Yes	Yes	No	Yes
Net Weight	0.2 lbs.	1.3 lbs.	0.8 lbs.	1.6 lbs.
Price (fob factory)	$450.00	$800.00	$490.00	$540.00

The Donner Model 4310 Precision Linear Servo Accelerometer is completely transistorized. A subminiature counterpart of standard Donner vacuum tube models, the Model 4310 delivers ±7.5 volts output at 0.05% linearity or better. Output will drive a 0-1 ma recorder directly. Total input power requirement is ±15 volts of unregulated dc power at milliwatt levels. Zero stability and linearity are enforced by the self-contained high gain servo system. MIL-USN silicon transistors allow operation from —40° C. to +100° C. The Model 4310 is recommended for measurement and control functions in airborne, vehicular, and ground based applications.

TEST INSTRUMENTS

MODEL 2102 WAVE ANALYZER

30 cps to 50kc coverage, 3% calibration accuracy. 160 μv to 500 volts rms full scale sensitivity. Broad and narrow crystal filter selectivities. VTVM reads harmonic components directly in percent and db. Simple operation, portability, reliability.

Price rack or cabinet, $545.00

MODEL 5002 NULL VOLTMETER

Measures dc voltage by comparison with a precision internal standard. Range: —100 to +100 volts. Direct reading to 0.1% accuracy. Null detection sensitivity, 0.5 μamp.

Price, $245.00

MODEL 2800 WOW AND FLUTTER METER

Accurately measures frequency modulation of an input signal, commonly known as "wow" or "flutter." Input frequency, 3000 cps ±5% or 1000 cps ±5%. Average input level, at 3kc, 0.1 to 50 v rms, at 1 kc, 5 to 50 v rms. Pass bands, 0.5 to 10 cps, 10 to 300 cps, and 0.5 to 300 cps.

Price, $345.00 cabinet; $365.00 rack.

Donner engineering representatives are located throughout the free world. Your nearest representative will be happy to arrange a demonstration of any Donner equipment and provide you with further information, or write directly to

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PRINTED IN U. S. A.
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